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Do organic surface films on sea salt aerosols influence atmospheric chemistry? – a model study

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Abstract. Organic material from the ocean's surface can be incorporated into sea salt aerosol particles often producing a surface film on the aerosol. Such an organic coating can reduce the mass transfer between the gas phase and the aerosol phase influencing sea salt chemistry in the marine atmosphere. To investigate these effects and their importance for the marine boundary layer (MBL) we used the one-dimensional numerical model MISTRA. We considered the uncertainties regarding the magnitude of uptake reduction, the concentrations of organic compounds in sea salt aerosols and the oxidation rate of the organics to analyse the possible influence of organic surfactants on gas and liquid phase chemistry with a special focus on halogen chemistry. By assuming destruction rates for the organic coating based on laboratory measurements we get a rapid destruction of the organic monolayer within the first meters of the MBL. Larger organic initial concentrations lead to a longer lifetime of the coating but lead also to an unrealistically strong decrease of O_3 concentrations as the organic film is destroyed by reaction with O_3. The lifetime of the film is increased by assuming smaller reactive uptake coefficients for O_3 or by assuming that a part of the organic surfactants react with OH. With regard to tropospheric chemistry we found that gas phase concentrations for chlorine and bromine species decreased due to the decreased mass transfer between gas phase and aerosol phase. Aqueous phase chlorine concentrations also decreased but aqueous phase bromine concentrations increased. Differences for gas phase concentrations are in general smaller than for liquid phase concentrations. The effect on gas phase NO_2 or NO is very small (reduction less than 5%) whereas liquid phase NO_2 concentrations increased in some cases by nearly 100%. We list suggestions for further laboratory studies which are needed for improved model studies.

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